

---

# 1997 Inventory of Toxic Air Emissions

## Point, Area, and Mobile Sources

April 2001

---

*The 1997 inventory is an update of the full 1996 regional inventory which is an ongoing initiative of the air regulatory agencies in the eight Great Lake states and the province of Ontario.*

**Submitted by:**

Great Lakes Commission  
400 Fourth Street  
Ann Arbor, MI 48103-4816

**Submitted to:**

U.S. Environmental Protection Agency  
Region 5  
77 West Jackson Blvd.  
Chicago, IL 60604

**On behalf of:**

Illinois Environmental Protection Agency, Bureau of Air  
Indiana Department of Environmental Management, Office of Air Management  
Michigan Department of Environmental Quality, Air Quality Division  
Minnesota Pollution Control Agency, Environmental Outcomes Division  
New York Department of Environmental Conservation, Division of Air Resources  
Ohio Environmental Protection Agency, Division of Air Pollution Control  
Ontario Ministry of Environment, Environmental Monitoring and Reporting Branch  
Pennsylvania Department of Environmental Protection, Air Quality Control  
Wisconsin Department of Natural Resources, Bureau of Air Management

# Table of Contents

---

Table of Contents .....	i
List of Tables .....	ii
List of Figures .....	iv
Acronyms and Abbreviations .....	vii
Acknowledgments .....	x
<b>1. Introduction .....</b>	<b>1</b>
<b>2. Results .....</b>	<b>7</b>
<b>3. Conclusions .....</b>	<b>98</b>
<b>4. Appendices</b>	
Appendix A: Illinois Toxic Emissions Inventory .....	A-1
Appendix B: Indiana Toxic Emissions Inventory .....	B-1
Appendix C: Michigan Toxic Emissions Inventory .....	C-1
Appendix D: Minnesota Toxic Emissions Inventory .....	D-1
Appendix E: New York Toxic Emissions Inventory .....	E-1
Appendix F: Ohio Toxic Emissions Inventory .....	F-1
Appendix G: Ontario Toxic Emissions Inventory .....	G-1
Appendix H: Pennsylvania Toxic Emissions Inventory .....	H-1
Appendix I: Wisconsin Toxic Emissions Inventory .....	I-1
Appendix J: Methodology for Architectural Surface Coating .....	J-1
Appendix K: Methodology for Asphalt Paving .....	K-1
Appendix L: Methodology for Autobody Refinishing .....	L-1
Appendix M: Methodology for Consumer and Commercial Solvent Use .....	M-1
Appendix N: Methodology for Chromium Electroplating .....	N-1
Appendix O: Methodology for Dry Cleaning .....	O-1
Appendix P: Methodology for Gasoline Marketing .....	P-1
Appendix Q: Methodology for Graphic Arts .....	Q-1
Appendix R: Methodology for Hospital Sterilizers .....	R-1
Appendix S: Methodology for Human Cremation .....	S-1
Appendix T: Methodology for Industrial Surface Coating.....	T-1
Appendix U: Methodology for Marine Vessel Loading, Ballasting and Transit.....	U-1
Appendix V: Methodology for Municipal Landfills .....	V-1
Appendix W: Methodology for Open Burning.....	W-1
Appendix X: Methodology for Pesticide Use.....	X-1
Appendix Y: Methodology for Prescribed Burning .....	Y-1
Appendix Z: Methodology for Public Owned Treatment Works .....	Z-1
Appendix AA: Methodology for Residential Fuel Combustion (not incl. wood).....	AA-1
Appendix BB: Methodology for Residential Wood Combustion.....	BB-1
Appendix CC: Methodology for Solvent Cleaning .....	CC-1
Appendix DD: Methodology for Traffic Markings .....	DD-1
Appendix EE: Index of SIC codes .....	EE-1
Appendix FF: Index of SCC/AMS codes .....	FF-1
Appendix GG: Carcinogenicity ratings for inventory pollutants.....	GG-1
Appendix HH: Great Lakes Commission Regional Air Toxic Emissions Inventory Project Steering Committee .....	HH-1

# List of Tables

---

Table 1-1:	Great Lakes Commission’s list of 82 targeted toxic air pollutants .....	5
Table 2-1:	Summary of 1997 air toxics emissions from point, area, and mobile sources .....	9
Table 2-2:	The most significant source categories for the top five non-metal compounds .....	12
Table 2-3:	The most significant source categories for the top five metal compounds.....	12
Table 2-4:	Summary of 1997 air toxics emissions by SCC/AMS codes .....	13
Table A-1:	Illinois Statewide Summary of Emissions (lbs./yr.) .....	A-7
Table A-2:	Illinois Pollutant Codes .....	A-8
Table B-1:	Indiana Statewide Summary of Emissions (lbs./yr.) .....	B-7
Table B-2:	Indiana Pollutant Codes .....	B-9
Table C-1:	Michigan Statewide Summary of Emissions (lbs./yr.) .....	C-10
Table C-2:	Michigan Pollutant Codes .....	C-11
Table D-1:	Minnesota Area source categories and information sources for their activity data .....	D-13
Table D-2:	Minnesota Statewide Summary of Emissions (lbs./yr.) .....	D-15
Table D-3:	Minnesota Pollutant Codes .....	D-16
Table F-1:	Ohio Statewide Summary of Emissions (lbs./yr.) .....	F-5
Table F-2:	Ohio Pollutant Codes .....	F-6
Table G-1:	Ontario Statewide Summary of Emissions (lbs./yr.) .....	G-8
Table H-1:	Profile Codes Applied by SCC and Material .....	H-2
Table H-2:	Pennsylvania Statewide Summary of Emissions (lbs./yr.).....	H-5
Table H-3:	Pennsylvania Pollutant Codes.....	H-6
Table I-1:	Reporting thresholds (in pounds per year) for each of the pollutants inventoried for this project. ....	I-1
Table I-2:	Summary of the Wisconsin 1997 Statewide VMT Estimates .....	I-9
Table I-3:	Wisconsin - Statewide Summary of Emissions (lb./yr.) .....	I-13
Table I-4:	Wisconsin Pollutant Codes .....	I-14
Table J-1:	Speciation Profile for Architectural Surface Coating (CARB, 1991) .....	J-1
Table J-2:	VOC Emission Factors and Paint Usage Factors .....	J-2
Table K-1:	EIIP Table: 17.5-3 - Example Telephone Survey Form.....	K-3
Table K-2:	EIIP Table 17.5-3 - Asphalt Paving Emission Factors.....	K-4
Table L-1:	Descriptions of Different Methods for Calculating Emissions .....	L-1
Table L-2:	Data Elements Needed for Each Method .....	L-2
Table M-1:	Consumer and Commercial Solvent Product Categories and Emission Factors .....	M-3
Table M-2:	Per Capita Consumer and Commercial Solvent HAP Emission Factors (lb./yr./person).....	M-3
Table M-3:	Per Capita Consumer and Commercial Solvent HAP Emission Factors by Category (lb./yr./person).....	M-4
Table N-1:	Emission Factors from FIRE 5.1B .....	N-2
Table N-2:	Facility-Specific Information for 1997 .....	N-4
Table N-3:	Chromium Emissions (lbs.) by County .....	N-5
Table O-1:	Drycleaner Emission Factors .....	O-3
Table P-1:	SCC Codes for Transportation of Gasoline.....	P-2
Table P-2:	HAP Profile in Gasoline Vapor.....	P-2
Table P-3:	Emission Factors for Gasoline Truck in Transit .....	P-3
Table P-4:	SCC Codes for Gasoline Service Stations (Stage I and II) .....	P-5
Table P-5:	Emission Factors for Gasoline Service Stations (Stage I and II) .....	P-6
Table T-1:	Profiles in the (Industrial Surface Coating) Speciate Database.....	T-1
Table T-2:	VOC emission factors for Industrial Surface Coating.....	T-2
Table U-1:	Speciation Profiles for Toxins Associated with Marine Vessel Loading.....	U-1
Table U-2:	Toxic emission factors based on gallons transferred.....	U-1
Table Z-1:	Targeted toxic pollutants associated with POTWs.....	Z-2
Table AA-1:	Pollutants and Emission Factors for Coal Combustion Sources .....	AA-2

Table AA-2:	Pollutants and Emission Factors for Distillate Fuel .....	AA-3
Table AA-3:	Pollutants and Emission Factors for Natural Gas.....	AA-4
Table AA-4:	Pollutants and Emission Factors for Liquid Petroleum Gas.....	AA-5
Table AA-5:	Adjusted Emission Factors.....	AA-6
Table BB-1:	Emission Factors for Residential Wood Burning.....	BB-3
Table BB-2:	Estimated Average Annual Wood Consumption and Percent of Households that Burn Wood.....	BB-4
Table BB-3:	Adjusted Emission Factors.....	AA-6
Table BB-4:	Adjusted Emission Factors.....	AA-6
Table DD-1:	Pollutants emitted of interest to RAPIDS and Species Profile.....	DD-2

# List of Figures

---

Figure 2-1:	Acenaphthene; 1997 estimated emissions by source category for point, area & mobile sources .....	23
Figure 2-2:	Acenaphthylene; 1997 estimated emissions by source category for point, area & mobile sources .....	24
Figure 2-3:	Acetaldehyde; 1997 estimated emissions by source category for point, area & mobile sources .....	25
Figure 2-4:	Acrolein; 1997 estimated emissions by source category for point, area & mobile sources .....	26
Figure 2-5:	Acrylamide; 1997 estimated emissions by source category for point, area & mobile sources .....	27
Figure 2-6:	Acrylonitrile; 1997 estimated emissions by source category for point, area & mobile sources .....	28
Figure 2-7:	Anthracene; 1997 estimated emissions by source category for point, area & mobile sources .....	29
Figure 2-8:	Antimony; 1997 estimated emissions by source category for point, area & mobile sources .....	30
Figure 2-9:	Arsenic; 1997 estimated emissions by source category for point, area & mobile sources .....	31
Figure 2-10:	Atrazine; 1997 estimated emissions by source category for point, area & mobile sources .....	32
Figure 2-11:	Benz(a)anthracene; 1997 estimated emissions by source category for point, area & mobile sources .....	33
Figure 2-12:	Benzo(ghi)perylene; 1997 estimated emissions by source category for point, area & mobile sources .....	34
Figure 2-13:	Benzene; 1997 estimated emissions by source category for point, area & mobile sources .....	35
Figure 2-14:	Benzo(a)pyrene; 1997 estimated emissions by source category for point, area & mobile sources .....	36
Figure 2-15:	Benzo(b)fluoranthene; 1997 estimated emissions by source category for point, area & mobile sources .....	37
Figure 2-16:	Benzo(k)fluoranthene; 1997 estimated emissions by source category for point, area & mobile sources .....	38
Figure 2-17:	Beryllium; 1997 estimated emissions by source category for point, area & mobile sources .....	39
Figure 2-18:	1,3-Butadiene; 1997 estimated emissions by source category for point, area & mobile sources .....	40
Figure 2-19:	Cadmium; 1997 estimated emissions by source category for point, area & mobile sources .....	41
Figure 2-20:	Carbon Tetrachloride; 1997 estimated emissions by source category for point, area & mobile sources .....	42
Figure 2-21:	Chloroform; 1997 estimated emissions by source category for point, area & mobile sources .....	43
Figure 2-22:	Chromium; 1997 estimated emissions by source category for point, area & mobile sources .....	44
Figure 2-23:	Chromium VI; 1997 estimated emissions by source category for point, area & mobile sources .....	45
Figure 2-24:	Chrysene; 1997 estimated emissions by source category for point, area & mobile sources .....	46
Figure 2-25:	Cobalt; 1997 estimated emissions by source category for point, area & mobile sources .....	47

Figure 2-26:	Coke Oven GS; 1997 estimated emissions by source category for point, area & mobile sources .....	48
Figure 2-27:	Copper; 1997 estimated emissions by source category for point, area & mobile sources .....	49
Figure 2-28:	Dibenz(a,h)anthracene; 1997 estimated emissions by source category for point, area & mobile sources .....	50
Figure 2-29:	Ethylene Dibromide; 1997 estimated emissions by source category for point, area & mobile sources .....	51
Figure 2-30:	Di-n-butyl Phthalate; 1997 estimated emissions by source category for point, area & mobile sources .....	52
Figure 2-31:	Ethylene Dichloride; 1997 estimated emissions by source category for point, area & mobile sources .....	53
Figure 2-32:	Diethylhexyl Phthalate; 1997 estimated emissions by source category for point, area & mobile sources .....	54
Figure 2-33:	Di-n-octyl Phthalate; 1997 estimated emissions by source category for point, area & mobile sources .....	55
Figure 2-34:	Ethylbenzene; 1997 estimated emissions by source category for point, area & mobile sources .....	56
Figure 2-35:	Ethylene Oxide; 1997 estimated emissions by source category for point, area & mobile sources .....	57
Figure 2-36:	Fluoranthene; 1997 estimated emissions by source category for point, area & mobile sources .....	58
Figure 2-37:	Fluorene; 1997 estimated emissions by source category for point, area & mobile sources .....	59
Figure 2-38:	Formaldehyde; 1997 estimated emissions by source category for point, area & mobile sources .....	60
Figure 2-39:	Glycol Ethers; 1997 estimated emissions by source category for point, area & mobile sources .....	61
Figure 2-40:	Hexachloroethane; 1997 estimated emissions by source category for point, area & mobile sources .....	62
Figure 2-41:	Hexachlorobutadiene; 1997 estimated emissions by source category for point, area & mobile sources .....	63
Figure 2-42:	Hexachlorbenzene; 1997 estimated emissions by source category for point, area & mobile sources .....	64
Figure 2-43:	Hydrazine; 1997 estimated emissions by source category for point, area & mobile sources .....	65
Figure 2-44:	Indeno(1,2,3-cd)pyrene; 1997 estimated emissions by source category for point, area & mobile sources .....	66
Figure 2-45:	Lead; 1997 estimated emissions by source category for point and area sources .....	67
Figure 2-46:	Manganese; 1997 estimated emissions by source category for point and area sources .....	68
Figure 2-47:	Mercury; 1997 estimated emissions by source category for point and area sources .....	69
Figure 2-48:	Methylene Diphenyl Diisocyanate; 1997 estimated emissions by source category for point and area sources .....	70
Figure 2-49:	Methylene Chloride; 1997 estimated emissions by source category for point and area sources .....	71
Figure 2-50:	Naphthalene; 1997 estimated emissions by source category for point, area & mobile sources .....	72
Figure 2-51:	Nickel; 1997 estimated emissions by source category for point and area sources .....	73
Figure 2-52:	Polychlorinated Biphenyls (PCBs); 1997 estimated emissions by source category for point, area & mobile sources .....	74
Figure 2-53:	Polychlorinated Dibenzodioxins (PCDD); 1997 estimated emissions by source category for point, area & mobile sources .....	75

Figure 2-54:	Polychlorinated Dibenzofurans (PCDF); 1997 estimated emissions by source category for point, area & mobile sources .....	76
Figure 2-55:	Pentachlorophenol (PCP); 1997 estimated emissions by source category for point, area & mobile sources .....	77
Figure 2-56:	Tetrachloroethylene ((PERC); 1997 estimated emissions by source category for point, area & mobile sources .....	78
Figure 2-57:	Phenanthrene; 1997 estimated emissions by source category for point, area & mobile sources .....	79
Figure 2-58:	Phenol; 1997 estimated emissions by source category for point, area & mobile sources .....	80
Figure 2-59:	Phosgene; 1997 estimated emissions by source category for point, area & mobile sources .....	81
Figure 2-60:	Pyrene; 1997 estimated emissions by source category for point, area & mobile sources .....	82
Figure 2-61:	Styrene; 1997 estimated emissions by source category for point, area & mobile sources .....	83
Figure 2-62:	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD, 2378); 1997 estimated emissions by source category for point, area & mobile sources .....	84
Figure 2-63:	2,3,7,8-Tetrachlorodibenzo-p-furan (TCDF, 2378); 1997 estimated emissions by source category for point, area & mobile sources .....	85
Figure 2-64:	Methylene Chloroform (TCE, 111); 1997 estimated emissions by source category for point, area & mobile sources .....	86
Figure 2-65:	Toluene; 1997 estimated emissions by source category for point, area & mobile sources .....	87
Figure 2-66:	2,4-Toluene Diisocyanate; 1997 estimated emissions by source category for point, area & mobile sources .....	88
Figure 2-67:	Trichlorethylene; 1997 estimated emissions by source category for point, area & mobile sources .....	89
Figure 2-68:	2,4,5-Trichlorophenol; 1997 estimated emissions by source category for point, area & mobile sources .....	90
Figure 2-69:	2,4,6-Trichlorophenol; 1997 estimated emissions by source category for point, area & mobile sources .....	91
Figure 2-70:	Trifluralin; 1997 estimated emissions by source category for point, area & mobile sources .....	92
Figure 2-71:	Vinyl Chloride; 1997 estimated emissions by source category for point, area & mobile sources .....	93
Figure 2-72:	Xylenes (ISO); 1997 estimated emissions by source category for point, area & mobile sources .....	94
Figure 2-73:	Xylenes (META); 1997 estimated emissions by source category for point, area & mobile sources .....	95
Figure 2-74:	Xylenes (ORTHO); 1997 estimated emissions by source category for point, area & mobile sources .....	96
Figure 2-75:	Xylenes (PARA); 1997 estimated emissions by source category for point, area & mobile sources .....	97

# Acronyms and Abbreviations

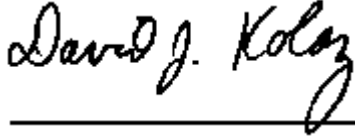
---

AIRS	Aerometric Information Retrieval System
AMS	Area and Mobile Source
BTU	British Thermal Unit
BW10	Break Wear less than 10 microns
CAA	Clean Air Act
CAR	California Air Resources Board
CAS	Chemical Abstract Service
DVMT	Daily Vehicle Miles Traveled
EET	Emission Estimating Techniques
EIIP	Emission Inventory Improvement Program
EIS	Emission Inventory System
ESP	Electrostatic Precipitator
EVHC	Evaporation Hydrocarbon
EXHC	Exhaust Hydrocarbon
EXPM	Exhaust Particulate Matter
FAEED	FAA Aircraft Engine Emission Database
FIRE	Factor Information Retrieval System
FPRT	Fuel Process Rate
GIS	Geographic Information Systems
GLC	Great Lakes Commission
GLEI	Great Lakes Emissions Inventory
GLIN	Great Lakes Information Network
GLNPO	Great Lakes National Program Office, U.S. Environmental Protection Agency
GLPF	Great Lakes Protection Fund
HAP	Hazardous Air Pollution
HDGV	Heavy-Duty Gasoline Vehicles
HDDV	Heavy-Duty Diesel Vehicles
IDEM	Indiana Department of Environmental Management
IEPA	Illinois Environmental Protection Agency
IJC	International Joint Commission
IMS	Information Management System
INDOT	Indiana Department of Transportation
LDDV	Light-Duty Diesel Vehicles
LDDT	Light-Duty Diesel Trucks
LDGV	Light-Duty Gasoline Vehicles
LDGT1	Light-Duty Gasoline Trucks
LDGT2	Light-Duty Gasoline Trucks
MACT	Maximum Achievable Control Technology
MC	Motorcycles
MCEI	Minnesota Criteria Pollutant Emission Inventory
MDEQ	Michigan Department of Environmental Quality
MOBILE5	U.S. EPA's Vehicle Emissions Model
MPCA	Minnesota Pollution Control Agency
MSDS	Material Safety Data Sheet
NATA	National Air Toxics Assessment
n.e.c.	Not Elsewhere Classified
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NEVES	Non-road Engine and Vehicle Emission Study
NO <sub>x</sub>	Nitrogen Oxides
NTI	National Toxic Inventory

NYDEC	New York Department of Environmental Conservation
OEPA	Ohio Environmental Protection Agency
OMS	Office of Mobile Standards
PAH	Polycyclic Aromatic Hydrocarbons
PART5	U.S. EPA's Highway Vehicle Particulate Emission Factor Model
PDEP	Pennsylvania Department of Environmental Protection
PM	Particulate Matter
POTW	Publicly Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
RAPIDS	Regional Air Pollutant Inventory Development System
RFG	Reformulated Gasoline
SAMS	SIP Air Pollutant Inventory Management System
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SSD	Source Summary Database
STEPS	State Environmental Programs Systems
TANKS	Storage Tank Emissions Software
TOG	Total Organic Gases
TRI	Toxic Release Inventory
TW10	Tire Wear less than 10 microns
U.S. EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture
VOC	Volatile Organic Compound
WDNR	Wisconsin Department of Natural Resources

# Great Lakes Regional Air Directors

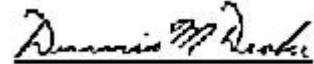
---



David J. Kolaz  
Bureau Chief  
Bureau of Air  
Illinois EPA



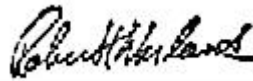
Janet McCabe  
Assistant Commissioner  
Office of Air Management  
Indiana DEM



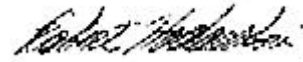
Dennis M. Drake  
Chief  
Air Quality Division  
Michigan DEQ



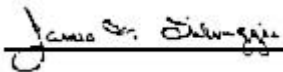
Michael J. Sandusky  
Director  
Environmental Outcomes Division  
Minnesota PCA



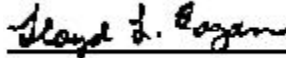
Robert Warland  
Director  
Division of Air Resources  
New York DEC



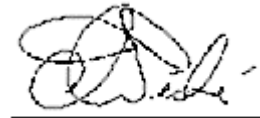
Robert F. Hodanbosi, P.E.  
Chief  
Division of Air Pollution Control  
Ohio EPA



James M. Salvaggio  
Director  
Bureau of Air Quality  
Pennsylvania DEP



Lloyd L. Eagan  
Director  
Bureau of Air Management  
Wisconsin DNR



Edward Piche  
Director  
Environmental Monitoring &  
Reporting Branch  
Ontario ME

# Acknowledgments

---

## *The Great Lakes Regional Air Toxic Emissions Inventory was compiled by the following Steering Committee members and associates*

- |   |   |
|---|---|
| ** Buzz Asselmeier<br>Bureau of Air<br>IL Environmental Protection Agency   | * Orlando Cabrera-Rivera<br>Joseph Tarter<br>Chris Bovee<br>Jie Quan<br>Bureau of Air Management<br>WI Dept. of Natural Resources |
| Chun-Yi Wu<br>Chris Nelson<br>Environmental Outcomes Division<br>MN Pollution Control Agency                              | Tom Velalis<br>Harry Judson<br>Loudajean Holloway<br>Division of Air Pollution Control<br>OH Environmental Protection Agency      |
| Gary Baker<br>Dennis McGeen<br>Air Quality Division<br>MI Dept. of Environmental Quality                                  | Peter Wong<br>George Georgakopoulos<br>Envir. Monitoring & Reporting Branch<br>ON Ministry of Environment                         |
| Robert McDonough<br>Kevin Watts<br>Kevin McGarrity<br>Division of Air Resources<br>NY Dept. of Environmental Conservation | Rob Altenburg<br>Bureau of Air Quality<br>PA Dept. of Environmental Protection  |
| Jon Bates<br>Office of Air Management<br>IN Dept. of Environmental Management   | * Denotes Steering Committee Chair<br>** Denotes Steering Committee Vice Chair  |

### **Observer**

Dr. Suzanne King  
U.S. EPA Region 5

The Great Lakes Regional Air Toxic Emissions Inventory has been a challenging endeavor for all involved. As an unprecedented effort to compile a regional inventory of toxic air emissions, a multitude of complex issues had to be resolved to ensure that the priorities of all Great Lakes jurisdictions - federal, state, and provincial - were adequately addressed.

This unique effort has benefited from the leadership of Orlando Cabrera-Rivera, chair of the Steering Committee for the Great Lakes Regional Air Toxic Emissions Inventory Project, Julie Wagemakers, project manager, Great Lakes Commission, and Buzz Asselmeier and Chun Yi Wu for administering the quality assurance and quality control checks on the inventory data. Ms. Wu conducted the Scope Study that looked at expanding the Great Lakes regional inventory to include mobile source emissions. The results of this study served as the basis for developing the mobile sources module in RAPIDS. The Steering Committee, composed of emission inventory specialists from the Great Lakes states, U.S. EPA and the province of Ontario worked together closely, making the project a team effort.

This report was written, compiled, and reviewed by all of the above project participants in addition to their staff. Editorial, report compilation and technical assistance was provided by Great Lakes Commission staff member Derek Moy. Project administration and oversight was provided by Dr. Michael J. Donahue, Commission executive director, and Julie Wagemakers, program manager, Communications and Information Management. Contractual support for software development was provided by Windsor Technologies, Inc.